The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Numerical Resolution of Eulers equations in a domain containing permeable moving boundary using immersed boundary methods with ghost points.

C. Bocquet[1], C. Desjouy[1] and G. Gabard[1]

[1] Laboratoire d'Acoustique de l'Universite du Mans (LAUM), UMR 6613, Institut d'Acoustique-Graduate School (IA-GS), CNRS, Le Mans Universite, France

Keywords: *Finite-Difference Time-Domain, Immersed Boundary Method, Moving boundary, High-order schemes*

Realistic acoustic problems often involve interactions between arbitrary-shaped moving objects at the interface with a fluid domain. The discretization of this kind of problem by a fixed Cartesian grid is particularly interesting since it allows to maintain low-memory storage and to directly use weakly-dispersive finite-difference schemes developed in the last decades. However, the description of non-Cartesian moving boundaries requires the implementation of non-trivial boundary conditions.

This work aims at developing numerical methods to take into account moving boundaries with potentially complex geometry in the context of acoustic problems.

Most of the studies reported in the literature have been conducted with low-order numerical schemes (order 1 or 2). However, in order to minimize the error on the acoustic wave number, one of the current challenges is to solve numerically with a high order of convergence. The reference problem posed in this study is the solution of the non-linear Euler equations by a finite-difference time-domain method, describing the formation of one-dimensional waves created by a moving piston.

The most suitable class of methods to solve this type of problem in the case of complex moving boundaries is the ghost-point method for sharp interface with 4th order reconstruction [1]. In order to accurately formulate the immersed boundaries with ghost points, the boundary conditions are formulated in terms of characteristic waves for the non-linear equations.

Moreover, few works taken into account moving permeable boundary conditions in the context of acoustic problems. To achieve this objective, a time-domain acoustic impedance model is coupled to the immersed boundary technique.

E-mail: constance.bocquet@univ-lemans.fr

REFERENCES

[1] J.F. Fidalgo, S.Clain, L. Ramirez, I. Colominas and X. Nogueira *Very high-order method on immersed curved domains for finite difference schemes with regular Cartesian grids*. Comput. Methods Appl. Mech. Engrg. 360 (2020) 112782.